

Nov. 10, 2013

Suggestions for studying:

① Do problems from Chapter 6 review.

Why? You remove the "prompt" telling which section's info you are using.

② Always, always ask why. You start to have an intuition about how to do the problem. The relevant formulas are only useful once you know they are relevant! Draw Venn diagrams.

Use sample #s (more on this in a bit).

Use "trees" to try to calculate.

③ Do the sample problems (online).

#20 p. 168

$S = \{ \text{people in population} \}$

$H = \{ \text{people with hepatitis} \}$

$T = \{ \text{people who test positive} \}$

Step 1: write down relevant sets/events

Information given to us:  $\Pr(T|H) = .95 \Rightarrow \Pr(T'|H) = .05$   
 $\Pr(T|H') = .10 \Rightarrow \Pr(T'|H') = .90$   
 $\Pr(H) = .0005$

Step 2: write down

what they tell you in terms of the sets you defined in step 1.

We want:

$$\Pr(H|T)$$

Step 3 write down what you want

↑ given the person tests pos

want: given T, what prob. do they actually have it?

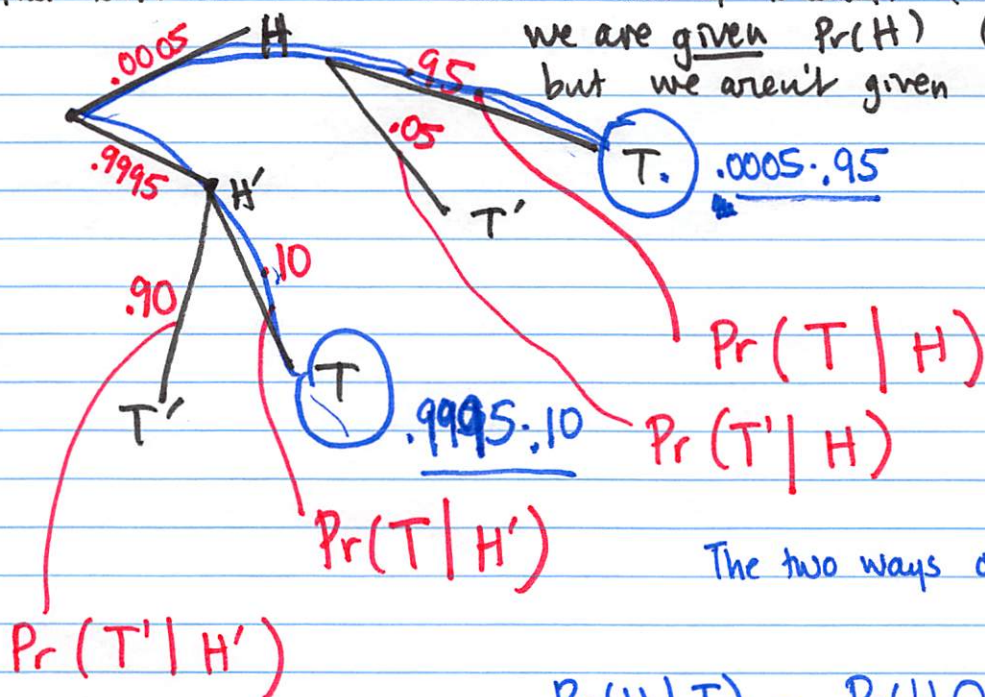
Use Bayes' Thm! Recall If  $B_1 \cup B_2 = S$  and  $B_1 \cap B_2 = \emptyset$   
Then

$$\Pr(B_1|A) = \frac{\Pr(B_1) \cdot \Pr(A|B_1)}{\Pr(B_1) \Pr(A|B_1) + \Pr(B_2) \Pr(A|B_2)}$$

Here we think of  $B_1$  as  $H$ , and  $B_2 = H'$ , and  $A$  as  $T$ .

$$\Pr(H|T) = \frac{\Pr(H) \Pr(T|H)}{\Pr(H) \Pr(T|H) + \Pr(H') \Pr(T|H')}$$
  
$$= \frac{(.0005) \cdot .95}{.0005 \cdot (.95) + .9995 \cdot .10} = .00473$$

Another look at this: TREES : start w/ H and H' (not T and T') because we are given Pr(H) (and therefore Pr(H')) but we aren't given Pr(T) and Pr(T').



Q: Find Pr(H|T)

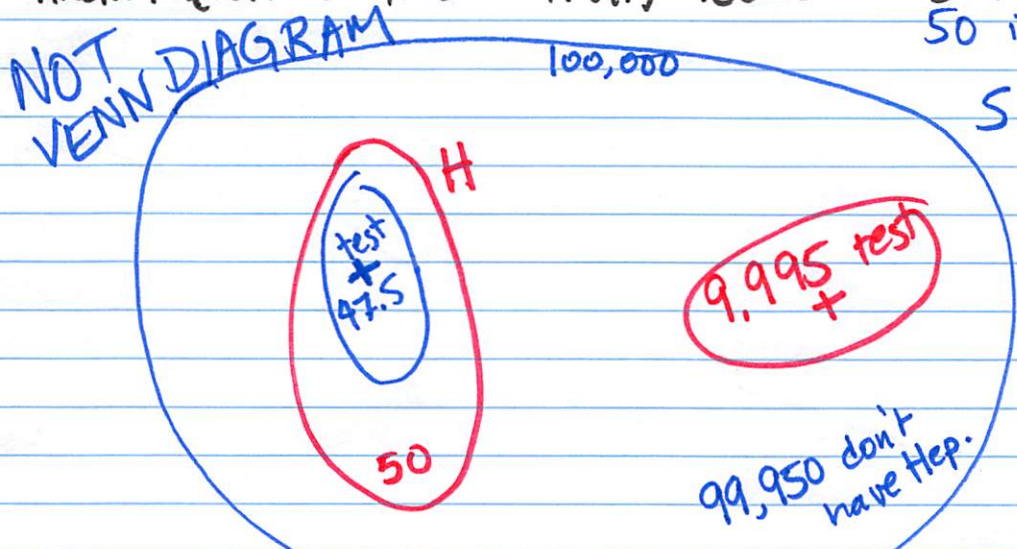
The two ways of getting a positive test :  
 $Pr(T) = .0005 \cdot .95 + .9995 \cdot .10$

$$Pr(H|T) = \frac{Pr(H \cap T)}{Pr(T)} = \frac{.0005 \cdot .95}{.0005 \cdot .95 + .9995 \cdot .10} = .00473$$

$$Pr(H \cap T) = Pr(H) \cdot Pr(T|H) = .0005 \cdot .95$$

$$\frac{Pr(H \cap T)}{Pr(H)} = Pr(T|H)$$

Another look at this: Pr(H) = .0005  $\Rightarrow$  5 in 10,000 people have hep. 50 in 100,000.



Pr(T|H) = .95  
 50 of 50 people test + 47.5 test + who have it

Tested pos:

$$9995 + 47.5 = 10042.5$$

$$Pr(H|T) = \frac{47.5}{10,042.5} = .00473$$

Out of 100,000 people, 50 of whom have it, 10,042.5 people test positive. Only 47.5 of them actually have it.

Last class... #4 p. 174

$$Pr(P_3 | L) = \frac{Pr(P_3) Pr(L | P_3)}{Pr(P_3) Pr(L | P_3) + Pr(P_3') Pr(L | P_3')}$$

$$P_3' = P_1 \cup P_2 \cup P_4$$

$$Pr(P_3') = .6$$

known      known  
 known      easy to calculate      calculated below.

Let's find  $Pr(L | P_3') = Pr(L | P_1 \cup P_2 \cup P_4)$

Not the sum  $Pr(L | P_1) + Pr(L | P_2) + Pr(L | P_4)$ .

$$Pr(L | P_1 \cup P_2 \cup P_4) = \frac{Pr(L | P_1) Pr(P_1) + Pr(L | P_2) Pr(P_2) + Pr(L | P_4) Pr(P_4)}{Pr(P_1) + Pr(P_2) + Pr(P_4)}$$

